# SYLLABUS
# ACADEMIC SESSION- 2023-24

## Generic Elective Papers (GE) (Minor-Chemistry) for other Departments/ Disciplines

## B.Sc. (HONOURS) II year
## Zoology/Biotechnology/Mathematics

**UNDERGRADUATE PROGRAMME**
**Choice Based Credit System (CBCS)**

## FACULTY OF SCIENCES
## MATA GUJRI COLLEGE FATEHGARH SAHIB
## (An Autonomous College)
## Affiliated to Punjabi University Patiala

Prof. (Dr.) Baljit Singh
Prof. (Dr.) Sonal Singhal
Mr. Ravinderjeet Singh
Mrs. Rachna Bhardwaj
Dr. Poonam Patiyar
Mr. Puneet Bhardwaj
Mrs. Priya Sharma
Dr. Kamalpreet Kaur
Mrs. Simrat Kaur
Dr. Kiran
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Mrs. Seema Maheshwari
Dr. Manpreet Kaur

**B.Sc. (HONOURS) II Year**

**SEMESTER III**

## BSHCHE-GE 3: CHEMISTRY III

Maximum marks; 100 Time: 3 Hrs.
External Examination: 75 Pass marks: 40%
Internal Assessment: 25
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

## Course Objectives

- To learn the concept of Phase equilibria and electrochemistry including the measurementof conductance and emf of the cell.
- To study the reactions, synthesis, and properties of Carboxylic acid & their derivates, aminesand diazonium salts.
- A relationship between structure, reactivity and biological properties of biomolecules isestablished through the study of these representative biomolecules.

## Course Outcomes

On the completion of the course, the students will be able to:

CO1: define the concepts of different types of binary solutions-miscible, partially miscible, and immiscible along with their applications.

CO2: construct Phase diagrams of one and two component systems. CO3: Test and compare the conductance of various electrolytes.

CO3: Predict the reaction mechanism and properties of carboxylic acid & their derivatives,amines and diazonium salts.

CO4: Analyze the unknown organic compound containing amino and carboxylate group.

CO5: demonstrate how the structure of biomolecules determines their chemical properties,reactivity and biological uses.

## Instructions for the Paper-Setter

The question paper will consist of three units: I, II and III. Unit I and II will have four questionsfrom each unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questionsfrom the whole syllabus and will be of 3 marks each.

## Instructions for the Candidates

Candidates are required to attempt two questions each from units: I and II, unit III is compulsory. Note: Internal assessment will be given on the basis of mid semester tests (12), class performance (6), assignments/quiz (7).

**UNIT-I**

**Phase Equilibria**

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur).

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**Conductance**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak andstrong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and moving boundary methods. Ionic mobility. Conductometric titrations (only acid base).

**Electrochemistry**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series and its applications. Potentiometric titrations -qualitative treatment (oxidation-reduction). **(30 lectures)**

**UNIT-II**

**Carboxylic acids and their derivatives**

Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Volhard - Zelinsky Reaction.

**Carboxylic acid derivatives (aliphatic):** (Upto 5 carbons)

*Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

**Amines and Diazonium Salts**

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

*Preparation*: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

**(30 Lectures)**

**Teaching-learning Activities:**

- Peer teaching and learning
- seminar presentation
- group tutorial
- Assignments
- use of e-learning resources

**Reference Books:**

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).

# BSHCHE-GE 3(L): CHEMISTRY III Lab

Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%

## Course Objectives:

- To develop skills required for the qualitative analysis of organic compounds.
- Enable the students to determine the various physical properties using simple instrumentalmethods like conductance and potentiometry.

## Course learning outcomes:

On the completion of the course, the students will be able to:

CO1: operate various analytical instruments such as potentiometer and conductometer.CO2: construct phase diagrams of two component systems.

CO3: determine CST and CSE of two component systems.

CO4: analyze qualitatively the organic compounds containing monofunctional groups.CO5: perform common laboratory techniques of paper chromatography to separate themixtures.

CO6: distinguish between reducing and non-reducing sugars by performing chemicaltests.

## UNIT-I

**a) Phase equilibria**

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the urea-watersystem.

**b) Conductance**

1. Determination of cell constant
2. Perform the following conductometric titrations:
   a) Strong acid vs. strong base
   b) Weak acid vs. strong base

**c) Potentiometry**

1. Perform the following potentiometric titrations:
   a) Strong acid vs. strong base
   b) Weak acid vs. strong base

## UNIT-II

**Qualitative Organic Analysis:**

Systematic qualitative organic analysis of organic compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one

derivative.

**Reference Books:**

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

## SEMESTER IV

## BSHCHE-GE 4: CHEMISTRY IV

External Examination: 75 Pass marks: 40%

InternalAssessment: 25

(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

## Course Objectives:

- To provide knowledge and understanding of properties, structure and uses of important compounds of s, p block elements,
- To understand the general characteristics of different states of matter.
- To impart knowledge to the students about the intermolecular forces in gases and liquids, the structure of solids, defects in solids.
- Student will also learn that how the various parameters such as temperature, pressureand presence of catalyst affect the rate of a reaction.

## Course Learning Outcomes

On the completion of the course, students will be able to:

**CO1:** illustrate the properties, structure, and uses of important compounds of s and p block elements.

**CO2:** derive ideal gas law from kinetic theory of gases and explain why the real gases deviatefrom ideal behavior.

**CO3:** explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases.

**CO4:** describe the properties of liquids especially surface tension and viscosity.

**CO5:** explain symmetry elements, crystal structure specially NaCl, KCl and CsCl.

**CO6:** define rate of reactions and the factors that affect the rates of reaction.

## Instructions for the Paper-Setter

The question paper will consist of three units: I, II and III. Unit I and II will have four questionsfrom each unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questionsfrom the whole syllabus and will be of 3 marks each.

## Instructions for the Candidates

Candidates are required to attempt two questions each from units: I and II, unit III is compulsory. Note: Internal assessment will be given on the basis of mid semester tests (12), class performance (6), assignments/quiz (7).

## UNIT-I

**Transition Elements (3*d* series)**

General group trends with special reference to electronic configuration, variable valency, color, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, color, magnetic properties, lanthanide contraction, separationof lanthanides (ion exchange method only).

**Coordination Chemistry**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature.

**Crystal Field Theory**

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitudeof D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. **(30 Lectures)**

## UNIT-II

**Kinetic Theory of Gases**

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation ofreal gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Boyle temperature (derivation not required). Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean squarevelocities (no derivation).

**Solids**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, ZnS and CsCl (qualitative treatment only).

**Chemical Kinetics**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants).Half–life of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates:Collision theory and Activated Complex theory of bimolecular reactions. **(30 Lectures)**

**Teaching learning activities:**

- Student directed learning: small groups of students are given individual assignments.Then they will introduce their assignment in the form of: PowerPoint presentation.

- Lectures supported by group tutorial work.
- Technology enabled learning.
- Peer teaching and learning.

**Reference Books:**

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage LearningIndia Pvt. Ltd., New Delhi (2009).

# SEMESTER IV

## BSHCHE-GE 4(L): CHEMISTRY IV Lab

**(Credits 2)**

Max. Marks: 50 No. of Lectures: 60 Hrs.

Time Allowed: 3 hrs. Pass Marks: 40%

**Course Objectives:**

- To impart the students a thorough knowledge of systematic qualitative analysis of mixturescontaining two acid and two basic radicals with interfering radical by semi-micro methods.
- To develop experimental skills in viscosity, surface tension and inorganic estimations.

**Course Learning Outcomes**:

On the completion of the course, the students will be able to

**CO1:** identify acidic and basic radicals in the given unknown sample.

**CO2**: estimate the total hardness (temporary and permanent) of water in a givensample.

**CO3:** Interpret the results obtained by the stalagmometer and Ostwald's viscometer.

**CO4:** determine the surface tension and viscosity of an unknown sample.

**CO5**: measure the kinetics of a chemical reaction.

**UNIT-I**

Semi-micro qualitative analysis (using $H_2S$ or other methods) of mixtures - not more than fourionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations: $NH_4^+$, $Pb^{2+}$, $Bi^{3+}$, $Cu^{2+}$, $Fe^{3+}$, $Al^{3+}$, $Co^{2+}$, $Ni^{2+}$, $Mn^{2+}$, $Zn^{2+}$, $Ba^{2+}$, $Sr^{2+}$, $Ca^{2+}$, $K^+$

Anions: $CO_3^{2-}$, $C_2O_4^{2-}$ $S^{2-}$, $SO_4^{2-}$, $S_2O_3^{2-}$, $NO_2^-$, $CH_3COO^-$, $Cl^-$, $Br^-$, $I^-$, $NO_3^-$, $SO_4^{2-}$, $PO_4^{3-}$

*(Spot tests should be carried out wherever feasible)*

**UNIT-II**

**(I) Surface tension measurement** (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with different concentration.

**(II) Viscosity measurement** (use of organic solvents excluded).

a) Determination of the absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

**(III) Chemical Kinetics**

Study the kinetics of the following reactions.

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

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b. Saponification of ethyl acetate.

**Teaching learning activities:**

- Viva-voce
- Laboratory-based practical components and experiments.

**Reference Books:**

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand& Co.: New Delhi (2011)